Bacteriology in patients with chronic sinusitis who have been medically and surgically treated

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Abstract
Chronic sinusitis is a disease that afflicts a significant percentage of the population and causes considerable long-term morbidity. The common use of multiple broad-spectrum oral antibiotics and endoscopic sinus surgery to treat this condition may alter the pathogens that promote persistence of chronic sinusitis. Forty-eight culture-positive patients with chronic sinusitis who had been medically treated for at least 3 months and had undergone sinus surgery were bacteriologically evaluated. Swab specimens of the middle meatus and sphenoid recess were aseptically obtained endoscopically and cultured for aerobes. Coagulase-negative staphylococci were the most common isolates (45.8%), followed by Streptococcus pneumoniae (16.7%), Enterobacteriaceae (16.7%), Staphylococcus aureus (10.4%), and Pseudomonas aeruginosa (10.4%). Coagulase-negative staphylococci were the most frequently isolated organisms in our study, as in many other studies. Despite the significant predominance of these organisms, they have always been assumed to be contaminants, and their presence in culture has been discounted. Coagulase-negative S aureus may be a pathogen in the chronic sinusitis process, and sensitivities of this isolate should be obtained for evaluation and possible treatment of the disease.

Introduction
The microbiology of the nose and sinus mucosa has been well studied, particularly in recent years. This has come about partly because of improved techniques in culturing methods. The density and diversity of normal flora vary greatly between the nose and sinuses. Nasal mucus has a bacterial concentration ranging from $10^3$ to $10^6$ bacteria per milliliter.1,2 Presumably, the nasal mucous membranes are sterile prior to birth but become colonized during passage through the vaginal canal.3 The Staphylococcus carrier rate is highest in newborn infants and declines gradually with age.4,5 The most important factor in determining the floral composition at a given site is the local environment, which includes such factors as moisture, temperature, the oxidation reduction potential and partial pressures of oxygen ($P_{O_2}$) and carbon dioxide ($P_{CO_2}$), pH, ionic composition, local nutrients, other microbiologic competition, and adherence affinities. In the nose and sinuses, all of these factors are influenced by two other factors. The first factor is the presence of lysozyme, lactoferrin, and other immunologically active proteins, including immunoglobulin A (IgA), which are found in normal nasal mucus. The second factor is the action of the cilia, both in propelling microorganisms into the nasopharynx and preventing the retrograde migration of nasopharyngeal bacteria into the nasal cavity.6

Chronic sinusitis is defined as a sinus infection that has persisted for longer than 3 months. If the mucociliary defense mechanisms are sufficiently damaged, patients may develop chronic sinusitis. Once established, this condition is best thought of as structural damage rather than as a purely infectious process that can be cured with antimicrobial agents. There is probably an alteration in the pathogens of chronic sinusitis as a result of frequent use of multiple courses of broad-spectrum oral antibiotics. The present study evaluates the bacteriology in patients who had been medically treated for at least 3 months with broad-spectrum antibiotics and nasal and systemic steroids before undergoing endoscopic surgery because of chronic sinusitis and purulent discharge in the nasal cavity.

Material and methods
Patients with chronic sinusitis who had been medically
treated for at least 3 months with broad-spectrum antibiotics and local steroids and had undergone endoscopic sinus surgery in the Otolaryngology Department of the Sivas Kizilay Medical Center (Sivas, Turkey) were selected for this study. The diagnosis of chronic sinusitis was based on clinical and radiographic examinations. Swab specimens of the middle meatus and the sphenoethmoidal recess were collected under endoscopic vision without touching the nasal vestibule and mucosa. The specimens were inoculated into enrichment media (bouillon) and incubated for 4 hours. Then the inoculation was transferred onto 5% sheep blood and eosine methylene blue agars. After incubation for 24 hours, identification was performed by using the BBL™ Crystal™ bacterial differentiation system (Becton, Dickinson and Company, Franklin Lakes, N.J.). The identification process was done according to the manufacturer’s instructions.

Forty-eight culture-positive patients were enrolled in this study, 20 men and 28 women, with an average age of 32 years (range: 16 to 58). Six additional patients whose cultures yielded no bacterial growth were not included in the study. All of the patients had had at least one sinus surgery; two patients had had two surgeries. Swab cultures of the middle meatus and sphenoethmoidal recess, which appeared with purulent discharge, were taken. None of the study subjects had cystic fibrosis or was immunocompromised.

Results
Coagulase-negative staphylococci were found in 22 of the 48 patients (45.8%). We identified Staphylococcus aureus in 5 (10.4%) patients, Streptococcus pneumoniae in 8 (16.7%) patients, Pseudomonas aeruginosa in 5 (10.4%) patients, and Enterobacteriaceae in 8 (16.7%) patients.

Discussion
Although the common assumption has been that the normal paranasal sinuses are sterile, recent studies have shown that this is probably not the case. In one study, 12 asymptomatic adults undergoing elective surgery underwent aseptic aspiration of the maxillary sinus. Aerobic bacteria were isolated from all 12 patients, with seven anaerobic species being isolated, as well. Another study reported the same findings. Thus, the sinuses do contain a bacterial flora in low concentrations. These bacteria may proliferate to cause bacterial infection under conditions that defeat the normal mucociliary defense mechanisms. Based on the findings of Kremer et al., a bacteriologic differentiation between patients with and without sinusitis is not possible.

Traditionally, medical therapy for chronic sinusitis has been guided by empiric data for antibiotic selection. Although Jiang et al. showed that treatment with amoxicillin-clavulanate potassium did not change the bacteriology of chronic sinusitis, the long-term use of multiple courses of broad-spectrum oral antibiotics to treat this condition may alter the pathogens in ways that promote a persistent chronic sinusitis. The patients in our study had been treated with broad-spectrum oral antibiotics and both topical and systemic steroids. We kept patients on topical corticosteroid therapy for 2 weeks after surgery, since Nadel et al. had demonstrated that topical steroid use has no statistically significant effect on bacterial cultures.

Jiang et al. demonstrated that mucosal specimens of the maxillary and ethmoid sinuses did not give more accurate results than swab specimens that were taken endoscopically. Vogan et al. demonstrated that endoscopically guided middle meatal cultures accurately identified the predominant bacterial pathogen and correlated with the cultures from maxillary sinus aspiration in more than 90% of infections. They also suggested that endoscopically guided sinonasal cultures hold promise as a viable alternative to maxillary sinus aspiration. Orobello et al. found a strong correlation between middle meatal cultures and both maxillary and ethmoid sinus cultures in children, even though gross purulence was rarely encountered in their patients. They concluded that middle meatal cultures accurately reflected maxillary and ethmoid sinus pathogens and could be used to direct antimicrobial therapy. In our study we used swab cultures of the middle meatus and/or sphenoethmoidal recess, depending on the endoscopic evidence of chronic sinusitis.

Anaerobic bacteria have long been implicated as the causative pathogens of chronic sinusitis. This was established by Frederick and Braude and by Brook. However, in studies by Karma et al., Doyle and Woodham, Muntz and Lusk, Orobello et al., Hoyt, and Almador et al., anaerobic organisms were cultured in 6% or less of their series. These studies all implicated aerobic bacteria, predominantly S. aureus and streptococcal species. Our study is consistent with Hoyt’s results, which demonstrated a preponderance of coagulase-negative staphylococci. The table reviews the findings of prior bacteriologic examinations of chronic sinusitis as well as those of the present study.

Conclusion
Interestingly, the predominant organisms cultured in all the above studies were coagulase-negative staphylococci. Despite the significant predominance of these organisms (22 to 75% of all isolates), they have always been assumed to be contaminants, and their presence in cultures has been discounted. However, coagulase-negative staphylococci have been implicated as virulent pathogens in neutropenic and neonatal sepsis, endocarditis, and urinary tract and burn-related infections.
may be a pathogen in the chronic sinusitis process, and sensitivities of this isolate should be obtained for evaluation and possible treatment of disease.

Table. Review of bacteriologic studies in patients with chronic sinusitis

<table>
<thead>
<tr>
<th>Author(s)</th>
<th>Year</th>
<th>Isolates</th>
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<tbody>
<tr>
<td>Karma et al 17</td>
<td>1979</td>
<td>Streptococcus viridans, Haemophilus influenzae, anaerobic bacteria (18%)</td>
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<tr>
<td>Brook 2 1981</td>
<td></td>
<td>Anaerobic bacteria (100%), α-streptococcus, Staphylococcus aureus, H influenzae</td>
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<tr>
<td>Almadori et al 18 1986</td>
<td></td>
<td>Coagulase-negative staphylococci (22%), S aureus, Streptococcus pneumoniae, anaerobic bacteria (6%)</td>
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<tr>
<td>Doyle and Woodham 1989</td>
<td></td>
<td>Anaerobic bacteria (88%), S aureus, α-streptococcus</td>
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<tr>
<td>Muntz and Lusk 19 1991</td>
<td></td>
<td>Coagulase-negative staphylococci (71%), S aureus, Enterobacteriaceae, Proteus</td>
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<tr>
<td>Orobello et al 14 1991</td>
<td></td>
<td>Coagulase-negative staphylococci (44%), S aureus, S viridans</td>
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<tr>
<td>Hoyt 20 1992</td>
<td></td>
<td>Coagulase-negative staphylococci (47%), S aureus, S pneumoniae, Enterobacter</td>
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<tr>
<td>Biel et al 21 1998</td>
<td></td>
<td>Coagulase-negative staphylococci (36%), S aureus, S viridans, anaerobic bacteria (6.5%)</td>
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<tr>
<td>Present study 2002</td>
<td></td>
<td>Coagulase-negative staphylococci (45.8%), S pneumoniae (16.7%), Enterobacteriaceae (16.7%), S aureus (10.4%), Pseudomonas aeruginosa (10.4%)</td>
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References